

PORTABLE APPARATUS FOR IDENTIFICATION VERIFICATION

Related Applications

This application claims the benefit of provisional application,
U.S. Serial No. 60/162,592, filed on October 29, 1999, entitled "PORTABLE
5 APPARATUS FOR IDENTIFICATION VERIFICATION", by Fisher et al.

Technical Field

The present invention relates to apparatus for the live scanning of fingerprint,
facial and crime scene images and more particularly to a portable apparatus for the
10 scanning and capture of fingerprint, facial and crime scene images and the wireless
transmission of said images to a central location for identity verification.

Background of the Invention

Over the years, the most commonly used techniques for both identity
15 verification and the identification of potential crime suspects have been the use of
fingerprints and photographs or "mug shots".

Originally, fingerprinting was done by inking a suspect's finger and
applying the inked finger to paper. As can be readily understood, fingerprint
information in this form was difficult to use. Making a fingerprint match was an
20 extremely time-consuming task. Digital technology significantly advanced the art of
fingerprinting. Inked images could be scanned, the image digitized and recorded in a
manner that could later be searched in a reasonably expeditious manner by
computer. Problems arose, however, due to the quality of inked images. Over- and
under-inking resulted in blurred or vague images, thus rendering the digitized
25 information useless. Further, the process of scanning an inked image was relatively
time-consuming.

These and other problems led to "live scanning". According to live
scanning techniques, the fingerprint of a suspect is scanned directly from the
suspect's finger, as opposed to being scanned from an inked image of the print. More
30 specifically, live scans are those procedures that capture fingerprint ridge detail in a
manner which allows for the immediate processing of the fingerprint image with a
computer. Original work in the field dates back to original patents filed in 1964

opaque material such as black paint. The prism is designed to utilize the optical principle of frustration of total internal reflection as described in Fishbine et al. U.S. Pat. No. 4,811,414. These properties result in a visual fingerprint image of a finger placed on the finger-receiving surface with "light" areas corresponding to ridges of the fingerprint and "dark" areas corresponding to valleys of the fingerprint. The image is captured using a video camera and the data is digitized for display, storage, and transmission. Optical fingerprint sensors, as described in the reference patent, require complex optical path corrections. Video cameras, prisms, lenses, and mirrors used in the system must be precisely located.

An investigator at an incident scene is often at risk due to lack of information. If a suspect or witness feels the investigator will obtain information that will incriminate them, the risk to the investigator is increased. In these situations, investigator safety is increased if the portable device for capturing images may be operated using a single hand. Although mobile, the system described in Fishbine et al, Patent No. 5,222,152, does not allow for single-handed operation. Single handed operation means the ability to hold the device in one hand and use the same hand to control the device while conducting an investigation. The portable system described in Fishbine et al, Patent No. 5,222,152, required the officer to use both hands, holding the device in one hand while using the other hand to capture images or enter text. In capturing images, the operator holds the device in one hand and is required to align the suspect's finger in the correct position to capture a usable print. There is a need for a system that allows for single hand operation and image gathering. This would provide a law enforcement officer with additional safety by having one hand free to protect oneself from potential harm that may be inflicted by a suspect.

The orientation and location of a captured fingerprint significantly impacts the quality of the response received from the search system. It is important to align the finger along the capture surface properly, capture the core of the print, and prevent movement by the witness or suspect as the print is being captured. It is desirable for the system to orient and align the finger without requiring the officer to use both hands.

Any optical fingerprint system is susceptible to intense ambient lighting. Intense ambient light which strikes the fingerprint receiving surface produces bright images on the video camera which captures the fingerprint image. If the ambient light intensity is equivalent to the light source of the fingerprint capture system, the bright spots will interfere with the fingerprint image being captured. Thus, when the finger-receiving surface on the system disclosed in Fishbine et al, Patent No. 5,222,152, was exposed directly to ambient lighting, the operator was required to reorient the device to eliminate interference from the bright ambient lighting. During an investigation, these extra actions are undesirable.

Summary of the Invention

In accordance with the present invention, the above and other problems are solved by providing the present invention which is a portable and lightweight fingerprint scanning apparatus that can optically scan and record fingerprint images in the field and transmit said images to a wireless mobile unit for processing and subsequent wireless transmission to a central location for the purpose of providing immediate identity and background checks on individuals being fingerprinted in the field. The apparatus of the present invention includes a fingerprint scanner and a wireless transmitter to transmit the fingerprint image to a mobile unit. In the preferred embodiment the present invention also provides for the capability of using a video camera to capture a photographic image or "mug shot" for wireless transmission to a mobile unit. An embodiment of the present invention also provides the ability to preview the fingerprint and "mug shot" images on a video monitor and to control transmission and processing of the fingerprint and "mug shot" images by the mobile unit using a terminal processor or keypad located on the portable fingerprint scanning apparatus. In the present embodiment, the terminal processor within the portable device may be a Pentium processor. The present invention allows law enforcement professionals to perform immediate identity and background checks on an individual while in the field.

The utility of the present invention is that it may be operated singled handedly, and, it eliminates the problems caused by direct exposure of the finger-receiving surface to bright ambient lighting. This portable apparatus may also use solid state fingerprint sensors that eliminate the need for precise locations of

components, thus increasing reliability of the sensor over the life of the apparatus. Solid state sensors are also less sensitive to wet or dry fingerprints. The system also provides a mechanical means of providing both finger alignment and core position location thereby reducing the workload of the investigator while capturing a fingerprint. This reduction in workload improves investigator safety by allowing closer monitoring of the person being fingerprinted. The system also provides for the capture of "latent fingerprints" at the scene of a crime. The ability to search and capture "latent fingerprints" with a portable device reduces investigation time.

These and various other features as well as advantages, which characterize the present invention, will be apparent from a reading of the following detailed description and a review of the associated drawings.

Brief Description of the Drawings

Fig. 1 illustrates a hardware component block diagram of the portable identification verification system;

Fig. 2A - 2B illustrates perspective views of the present portable device, showing a light baffle attached and removed;

Fig. 3 illustrates perspective views of the present portable device, showing the ergonomic design of the single hand operation handle;

Fig. 4 illustrates a side view of the present portable device, showing the magnetic stripe and smart card reader and removably attached latent print alignment guide;

Fig. 5 is a flow diagram illustrating a flow diagram for a rolled fingerprint capture; and

Fig. 6 is a communication flow diagram illustrating the communication of information between the portable device and various system to which the portable device connects; and

Fig. 7 is an exemplary hardware environment for one embodiment of the present invention.

System Overview

5 The present invention comprises a portable apparatus for identification and verification with the ability to transmit, in real-time, data captured in the field to a central site for processing and subsequent return and display. The portable apparatus has the ability to allow the user to operate the device with a single hand. It may scan and record live fingerprint slap or *roll images* (via optical, solid state, or video sensors), and prevent bright light sources from interfering with fingerprint scans. It also includes a baffle that assists with the mechanical alignment of the fingerprints on the fingerprint sensor receiving surface. The portable device also may scan, display, and record latent fingerprint images. It also has other data receiving and transmission functions, such as displaying and recording facial and incident scene images in conditions ranging from well lit to total darkness. In addition, it provides for recording and play back of incident scene audio information for incident description and voice recordings of contacts for identification. The portable apparatus may also scan, record, and interpret magnetic stripe, smart card, or bar code information from standard and non-standard cards. It also obtains, displays, and records geographical position for incident description, mapping, and directional instruction to the user. It further provides an emergency transmission for assistance and provides a short-range wireless link to a mobile unit or *adirect wireless* link to the central site. It also provides for user entry of text data for demographics or operator use through either keyboard or voice activation.

When operating at an incident scene, data capture and management are the keys to being able to integrate all information. Multiple methods of data entry may be required in order to enter incident scene descriptions or information on a portable unit. The ability to enter text, dictate descriptions for recording, and scan information from bar codes, magnetic stripes, or smart cards, enables the investigator to retain and organize incident scene information directly with the identification information. This will give investigators the capability to conduct complex searches against multiple incidents.

30 In addition to textual or scanned data, the ability to geographically identify the location of site evidence automatically would increase the investigator's ability to reconstruct incident scenes in great detail. Automatic detection of

geographical position also allows the investigator to use advanced mapping programs that identify surrounding areas, giving the investigator additional information about the incident site. The same mapping function would also allow coordination and direction between different investigative teams or personnel. The automated detection of geographical position may be obtained using the global positioning system (GPS).

Investigators often are required to work in an area which potentially contains risk to the investigator. Suspects or witnesses are more likely to use physical violence if they feel the investigator has access to information that could incriminate them. It is desirable for the investigator to be able to send a message requesting assistance by using a single button; transmitting an "officer needs assistance" message to the central site. The expeditious use of this function could be the difference between life and death for an investigator in a violent situation.

Wireless transmittal of data to a central site provides expedient flow of information. The prior invention transmits data a short distance to a mobile unit that in turn relayed the information to the central site via existing law enforcement networks. The ability to directly link information to a central site, eliminating the need for a mobile unit as intermediary, gives the investigator increased flexibility, reliability and reduces transmission delays.

Detailed Description of the Invention

In the following detailed description of the preferred embodiments reference is made to the accompanying drawings that form a part hereof, and is shown by way of illustration specific embodiments in which the invention may be practiced. It is to be understood that the other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

Fig. 1 illustrates a hardware component block diagram of the portable identification verification system in accordance with the present invention. The major components of the portable identification verification system include image capture devices 26, external data entry devices 27, external interfaces 28, and a terminal 3. The terminal 3 controls the various functions of the portable

fingerprinting apparatus. The image capture devices 26 include an optical fingerprint sensor 1 and photo capture sensor 2. These sensors are used to detect and capture an image of a fingerprint. The external data entry devices 27 include a keypad input 4, magnetic stripe input 5, a barcode input 6, smart card input/output, 7 and audio capture and playback 8. These components allow rapid verification of evidence by transmitting the information via external interfaces 28. The external interfaces 28 include a GPS receiver 10 and wireless connectivity devices 9. These subcomponents will be explained in detail hereafter.

The embodiment of the system shown in Figs. 2A and 2B illustrates the incorporation of a removable light baffle that prevents excessive ambient light from interfering with the fingerprint scan. Fig. 2A illustrates a light baffle 30 removed from the fingerprint receiving surface 11 and Fig. 2B shows when the baffle 30 is mounted on the apparatus 12. The baffle mounting mechanism also aligns the fingerprint within the finger-receiving surface such that the fingerprint characteristics of interest are properly located with respect to the fingerprint capture sensor 1. The finger to be printed is inserted into the baffle 30 and slid forward against the baffle mounting mechanism. The front end of the finger is thus located such that the core of the fingerprint is within the central region of the fingerprint-receiving surface 11. The sides of the baffle mounting mechanism provide a channel that aligns the finger with the fingerprint-receiving surface 11 and minimizes the ability to rotate the finger during the fingerprint capture. The baffle 30 itself is removable for operation when ambient lighting does not require the baffle or when alignment and rotation mechanisms are not required, e.g., during roll fingerprint captures.

During the capture of a fingerprint it is desirable to position the core of the fingerprint over the center portion of the fingerprint-receiving surface 11. The core is the portion of the fingerprint that contains the most information, or minutiae used by automated fingerprint identification systems (AFIS). It also improves AFIS performance if the fingerprint is aligned with the fingerprint-receiving surface 11 such that the fingerprint image is not rotated when captured. An apparatus such as a light baffle 30, that provides both finger alignment and core position location will reduce the workload of the investigator while capturing a fingerprint. This reduction

LEDs as an illumination source. The photo capture sensor is capable of capturing black and white photo images using this illumination. In the current embodiment the device uses a video camera, such as a Sony video camera -model number FCB-EX470L, with integrated infrared LEDs. An alternate configuration could include a single board camera such as the Edmund Scientific high resolution monochrome micro camera, model number J53-307, along with standalone infrared LEDs and external lens magnification for latent capture.

Incident scenes are not always well lit. Traditional cameras using a flash system provide only a momentary improvement in lighting. They do not allow the operator to view the incident scene under the same lighting that the image will be captured. The ability to operate under an infrared source and display live video allows the operator to preview the images about to be recorded. The infrared source also overcomes lighting limitations and improves image quality. In the extreme condition that no light is available at the incident scene the combination of infrared light source and live video display gives the investigator a limited night sight capability.

The current embodiment of the system incorporates audio capture 8 via a far field microphone and digital audio chip set which will enable digital recording, voice recognition applications and speech recognition. The current embodiment of the system incorporates a sound card such as a SoundBlaster® compatible PC104 circuit card or an ADTECH PC104-3210. Future embodiments may incorporate SoundBlaster compatible chipsets, such as the Analog Devices AD1816 or Aureal Vortex 2. From the teachings provided herein, those skilled in the art appreciate that the foregoing description sets forth one embodiment of a soundcard, although other object circuit cards are possible.

Digital recordings may also be captured, stored, and transmitted to central sites to enable complete descriptions and demographic information to be filed along with incident reports. Digital recordings of incident scene witnesses or suspects may be retained for later analysis and identification purposes. Speech recognition will enable voice-activated control of the apparatus. The audio range of the device may be from about 200 to 3700 Hz. Sampling may be accomplished at

approximately 7400 Hz or greater to insure sufficient frequency resolution for post processing algorithms at central sites.

The system further includes a text entry device. In the current embodiment, the text entry device includes a keypad 4 and rotary dial. In addition, the system includes a magnetic card reader 5 that is attached to a dedicated RS-232 interface that allows the investigator to scan data directly from drivers' licenses, credit cards, or other forms of cards using magnetic stripes into the apparatus. An alternative embodiment could implement a bar code reader 6 in place of the magnetic card reader. In an alternative embodiment of the apparatus, a combined magnetic stripe and smart card reader 7 may be implemented in place of the magnetic stripe reader. The data from the magnetic stripe, smart card, or bar code reader may then be captured, stored, and transmitted wirelessly along with other information from the incident. The magnetic card reader 4, bar code reader 6, and smart card reader 7, are commercially available.

As illustrated in Figures 2 and 4, the apparatus includes both a docking connector 23 for direct link to a mobile unit in a squad car and a wireless connectivity device (see Fig. 1) via an RF link from the apparatus to the mobile unit in a squad car as shown in Fig. 6. This RF link may be a 2.4 GHz spread spectrum receiver/transmitter that provides a serial data stream to the mobile unit. The communication link may be a serial port, such as an RS-232 serial port, on the mobile unit in the squad car. In a preferred embodiment of the apparatus a data link from the apparatus to the mobile unit in the car may use a PCM/CIA port on the mobile unit to provide a 2.4 GHz spread spectrum signal capable of over 2.0 megabits/second communication. An alternative configuration providing lower cost may transmit data vis a 900 Mhz signal with data rates from about 19.2 kilobits/second to 115 kilobits/second. Both 2.4 GHz and 900 MHz are considered free frequency bands where general purpose communication may be accomplished. The specification of these frequencies provides for lower cost of hardware. However, embodiments of the apparatus could include other frequencies and data rates as specified by the operating agency.

Fig. 5 is a flow diagram illustrating a flow diagram for a rolled fingerprint capture according to the present invention. A rolled fingerprint image is

generated and captured by the portable device through merging multiple frames of the camera data stream. A frame in this context is the digitized stream 31 of data produced from the fingerprint imaging sensor that comprises a complete field of view for the sensor. The direction in which the roll is proceeding 32 is determined for the purpose of reducing data processing requirements on the system and also to provide user feedback relating to the progress of the roll image grab 33. As the finger is rolled across the fingerprint-receiving surface only a portion of the image contains fingerprint data. In knowing the direction the roll is proceeding, it is possible to predict the portion of the entire image which contains fingerprint data. This portion may then be processed 34 instead of the entire image. The result is a portable fingerprint capture device with the ability to capture, display, record, and transmit roll fingerprints to a central site for identification verification. An additional method of processing rolled fingerprints is disclosed in U.S. Patent No. 4,933,976, which is assigned to Digital Biometrics, Inc., is incorporated herein by reference as if fully set forth herein.

In one embodiment of the portable device, a solid state sensor is used in place of an optical fingerprint sensor 1. Solid state sensors are manufactured using semiconductor technology to integrate a sensor and the associated electronics on a single integrated circuit. The solid state sensor mechanism may be based on capacitive, impedance, acoustic, laser or polymer concepts. The integrated circuit is laid out such that the sensor mechanism is replicated in 0.02" spacing (500 sensors per inch) in both the horizontal and vertical direction. The solid state sensor is incorporated in the portable identification verification apparatus via communications buses to the terminal 3. These buses may be serial (RS-232, USB, or other advanced serial buses), parallel, or networked communications buses. The communication bus must be capable of obtaining images at a sufficient number of frames per second to meet the requirements for roll prints previously specified. In order to meet law enforcement minimum requirements, the preferred sensor will have a surface area of approximately 1" x 1". A solid state sensor will provide improved reliability and reduced cost and weight over an optical sensor.

Fig. 6 is a communication flow diagram illustrating the communication of information between the portable device and various system to

which the portable device connects according to the present invention. Another alternative configuration would eliminate all links to the mobile unit by providing a wireless link 22 from the apparatus 35 directly to the central site 36 via a communication switch 37 as shown in Fig. 6. The wireless format could be cellular (Cellular Digital Packet Data (CDPD), Mobitex, PCS, or other cellular service) or an RF network currently available in an area where the apparatus will be used. The types of coverage would be obtained by contacting local wireless service providers. The direct wireless link 22 is implemented via a PCM/CIA card such as the Novatel Merlin wireless modem.

10 The current embodiment of the apparatus includes interfaces to incorporate Global Positioning System, or GPS, satellite access 20 (as shown in Fig. 6) in the device. The current GPS interface may be accomplished via a dedicated RS-232 serial channel that communicates with available commercial GPS location sensors, such as the Global American GE7986 GPC receiver, in a PC104 form factor. Alternative configurations could interface with commercial GPS sensors using PCM/CIA interfaces such as the Premier Electronics Marco Polo GPS system. Future embodiments may directly incorporate GPS chipsets, such as the Rockwell 5-Channel GPS receiver. The GPS system may provide the user geographical location information within 25 meters. Advanced embodiments of the apparatus may provide geographical location information within 25 centimeters using differential GPS. The information provided by the GPS is available to other applications on the apparatus that provide functions for mapping or giving directions to investigators or other personnel involved in an incident.

25 Referring to Fig. 7, another hardware environment for identification and verification is shown 700 according to the present invention. The present invention may be implemented using a identification and verification processor 730, comprised of a processor 710 and memory (RAM) 740. It is envisioned that attached to the identification and verification processor 730 may be a memory device 740. Also included in this embodiment may be input devices 750, sensors to detect and input the desired image / data and interface to the user for downloading data and commands.

The identification and verification processor 730 may operate under the control of an operating system. The identification and verification processor 730 executes one or more computer programs under the control of the operating system.

Generally, the operating system and the circuit programs may be tangibly embodied in a computer-readable medium or carrier, e.g. one or more of the fixed or removable data storage devices 720, or other data storage or data communications devices. A quantizer 770 may be used for conversion of the analog signals to digital between the identification and verification processor 730 and any connecting digital device. Both operating system and the computer programs may be loaded from the data storage devices into the memory 740 of the identification and verification processor 730 for execution by the processor 710. Those skilled in the art will recognize that the memory 740 is optional, or may be a memory device embedded or otherwise couple to the identification and verification processor 730. Both the operating system and the generator programs comprise instructions which, when read and executed by the processor 710, cause the identification and verification processor 730 to perform the steps necessary to execute the steps or elements of the present invention. The resulting digital output 760 is produced.

Although one service request system configuration is illustrated in Fig. 7, those skilled in the art will recognize that any number of different configurations performing similar functions may be used in accordance with the present invention.

The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention may be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.